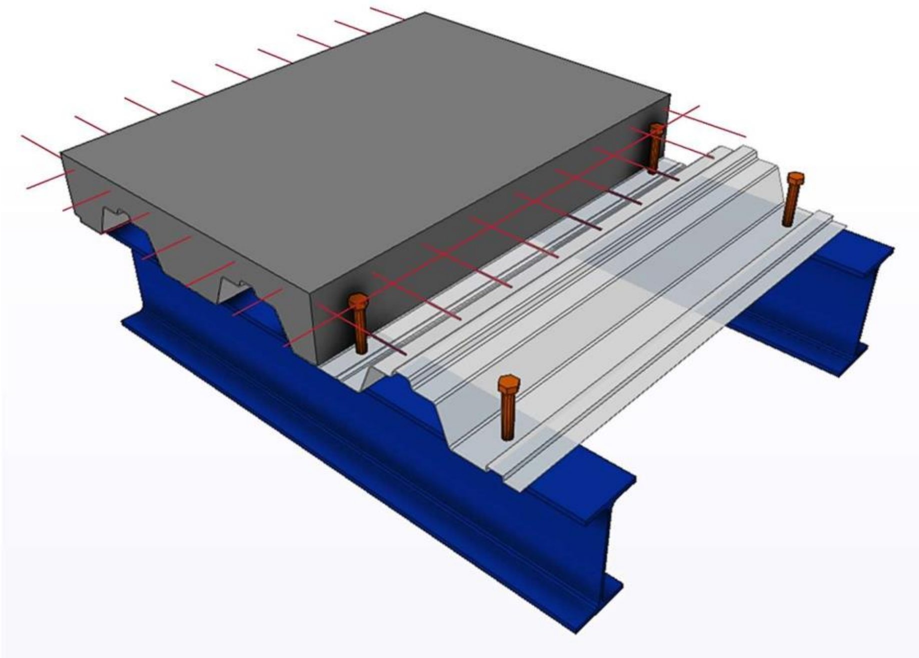


Mixed Slab Execution:

1. Erection of metal structure (beams);
2. Laying RM76 profiled sheet (Collaborating sheet);
3. Fitting connectors to connect the beam to the RM76 profiled sheeting;
4. Placing reinforcement;
5. Concreting.

Mixed slab design:

A composite slab is the result of combining a profiled steel sheet with a layer of concrete on top of it. In the initial phase of the construction process, the profiled sheet acts as a formwork for placing the concrete and, once the concrete has hardened, it acts as a tensile reinforcement for positive moments. Thus, in order to resist positive bending moments, the concrete works in compression and the steel of the profiled sheeting in traction, guaranteeing a torque of resistant forces. The main difference with reinforced concrete is the adhesion between the two materials, which in the case of composite slabs requires specific checking and attention. RM-76 profiled sheeting has the right characteristics to ensure that it is properly bonded to concrete on site. This construction solution can be used in residential buildings, commercial premises, workshops, industrial buildings and parking lots.

Advantages:

- Steel profiled sheeting is lighter than conventional formwork, which makes it considerably easier and quicker to handle and install on site;
- The profiled sheet, in addition to being a sturdy reinforcement, is itself a self-supporting formwork, the stripping phase is no longer necessary, and the use of shoring is reduced or even dispensed with;
- Since the slabs are ribbed, there is also a reduction in the volume (and weight) of concrete compared to a solid slab of the same thickness.

Mechanical characteristics of the different composite slab materials

RM-76 profiled sheet

Manufacturing: The structural-grade carbon steel sheet is coated with a continuous hot zinc bath

Manufacturing standards: EN 10326 / EN 10143

Minimum resistance class .... S320GD+Z

Minimum characteristic value of the yield strength of the sheet steel .... $fyb = f_{yp} = 320$ MPa

Minimum characteristic value of the tensile strength of the sheet steel .... $f_u = 390$ MPa

Modulus of elasticity of sheet steel .... $E_a = 210$ GPa

Zinc coating paste .... 140 g/m^2

Thickness of zinc coating .... 0.01 mm/face

Partial coefficient of safety for ultimate limit states: .... $\gamma_a = \gamma_{m0} = \gamma_{m1} = 1.00$

Concrete

Minimum resistance class C25/30

Minimum characteristic value of the tensile strength of concrete in compression in cylinders at 28 days of age C25/30

Bulk weight of reinforced concrete .... 25 kN/m^3

Volume weight of fresh reinforced concrete .... 26 kN/m^3

Partial coefficient of safety for ultimate limit states: .... $\gamma_C = 1.50$

Steel rod or electrowelded mesh

Minimum strength and ductility class .... A500 NR SD (B500C, according to standard EN 10027-1)

Minimum characteristic value of the tensile yield strength of the reinforcing steel .... $f_{yk} = 500$ MPa

Partial coefficient of safety for ultimate limit states: .... $\gamma_S = 1.15$

Distribution reinforcements (A500 NR SD)

The minimum distribution reinforcement A_s^{dist} to be placed on the composite slab in each direction is shown in the table 1.

Table 1 - Distribution reinforcement to be arranged in each direction

Total slab thickness (cm)	12	13	14	15	16	18	20
A_s^{dist} (cm^2/m)	0.8	0.8	0.8	0.9	1.0	1.2	1.4

Ordinary continuity reinforcements (Ø10, A500 NR SD)

In continuous composite slabs, the ordinary reinforcement to be provided on the top face to absorb the negative bending moments on the supports (AS-) is shown in Table 2. The values of the areas of ordinary continuity reinforcement in Table 2 represent the maximum values obtained in the calculations in each of the columns of the direct design tables for continuous composite slabs. However, the designer can calculate the ordinary continuity reinforcement for their specific slab in order to obtain a smaller reinforcement than the one in Table 2.

Table 2 - Reinforcement to absorb the negative bending moments at the continuity supports.

	Total slab thickness (cm)	12	13	14	15	16	18	20
A_s^{dist} (cm^2/m)	e = 0.8 mm	4.0	4.0	4.0	4.0	4.0	4.2	4.9
	e = 1.0 mm	4.4	4.4	4.4	4.4	4.4	4.4	4.9
	e = 1.2 mm	4.8	4.8	4.8	4.8	4.8	4.8	4.9

CONSTRUCTION PROVISIONS FOR COMPOSITE SLABS

NP EN 1994-1-1 imposes certain limits in terms of the concrete section and the support conditions of the profiled sheeting for the correct use of a steel-concrete composite slab. These construction provisions are summarized below.

Minimum thickness

The following minimum thicknesses are defined for the cross-section of composite slabss:

- ✓ For composite slabs without bracing: minimum concrete thickness of 40 mm above the profiled sheet and minimum total thickness of the composite slab of 80 mm (ver Fig. 1).

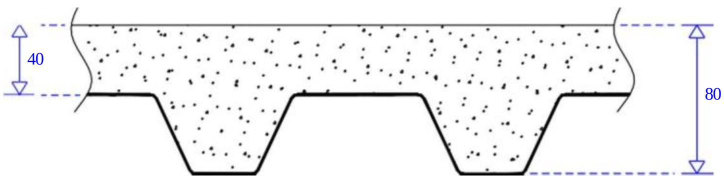


Fig. 1 - Minimum thicknesses [mm] of the cross-section of a composite slab without bracing functions

- ✓ For mixed slabs with diaphragm functions: minimum concrete thickness of 50 mm above the profiled sheet and minimum total thickness of the mixed slab of 90 mm (ver Fig. 2).

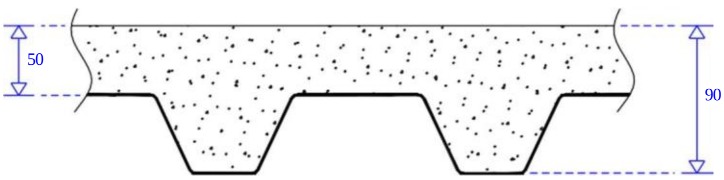
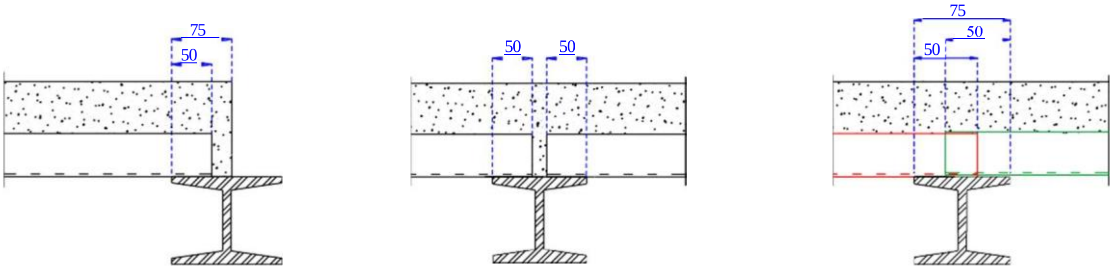


Fig. 2 – Minimum thicknesses [mm] of the cross-section of a composite slab with diaphragm functions.

SUPPORT CONDITIONS

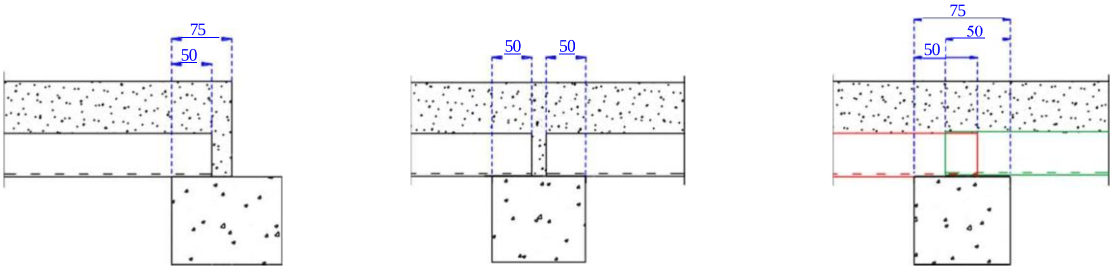
The following minimum distances are defined for the support conditions of profiled sheeting:

- ✓ Support on steel or reinforced concrete beams: minimum support distance of the profiled sheet on the beam of 50 mm and minimum total support distance of the composite slab on the beam of 75 mm (ver Fig. 3 e Fig. 4).



a) Extreme support   b) Wide intermediate support   c) Narrow intermediate support

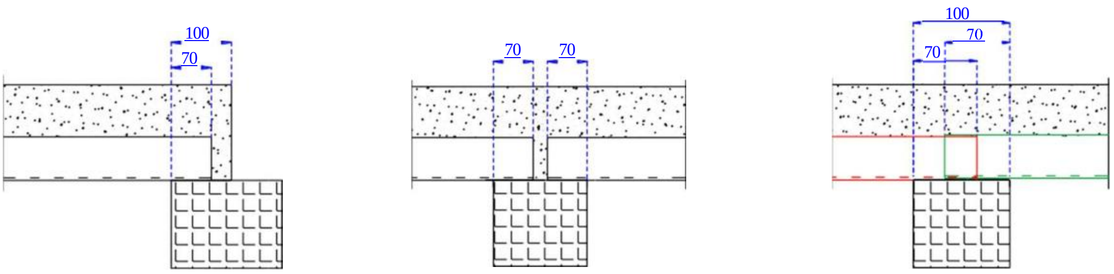
Fig. 3 – Minimum support distances [mm] on metal beam.



a) Extreme support   b) Wide intermediate support   c) Narrow intermediate support

Fig. 4 – Minimum support distances [mm] in reinforced concrete beams.

- ✓ For support on beams made of other materials: minimum support distance of the profiled sheet on the beam of 70 mm and minimum total support distance of the composite slab on the beam of 100 mm (ver Fig. 14).



a) Extreme support   b) Wide intermediate support   c) Narrow intermediate support

Fig. 5 – Minimum support distances [mm] on beams made of other materials.

Armor

When reinforcing concrete, reinforcement may be required for various purposes:

- ✓ Distribution reinforcement - reinforcement is required in each direction to take account of the shrinkage of the concrete and the distribution of point loads, which must be placed 25 mm from the top surface of the concrete (see Fig. 6) and can be consulted in Table 1.

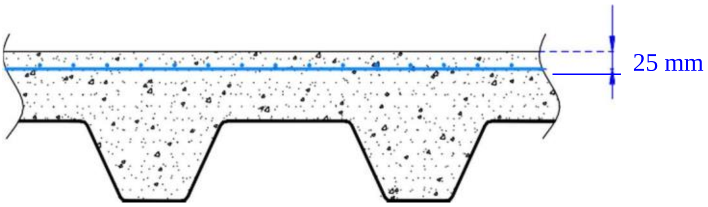


Fig. 6 – Distribution armature.

- ✓ Continuity reinforcement - designed to guarantee continuity and limit cracking on intermediate supports (negative bending moments). For consecutive spans of approximately equal lengths, the continuity reinforcement should be extended beyond the axis of the support by about 30% of the span, placed at a depth of 25 mm (see Fig. 7) and can be consulted in the Table 2.

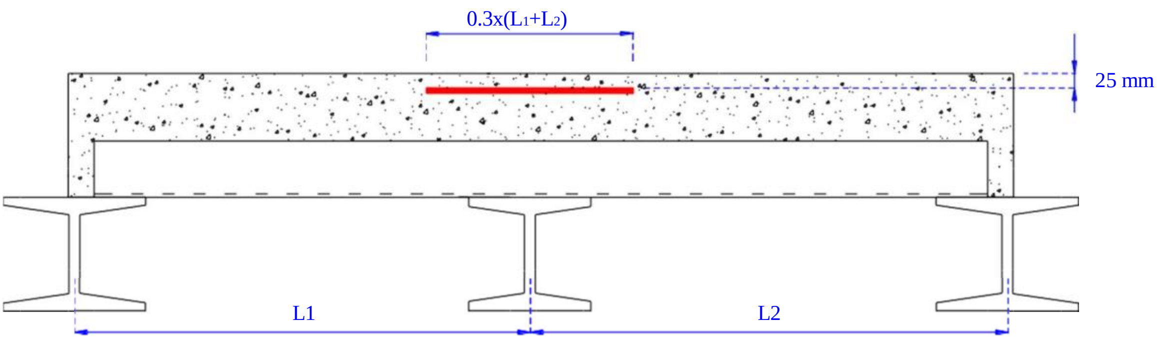


Fig. 7 – Arrangement of continuity reinforcement on intermediate supports for approximately equal spans.

- ✓ Additional reinforcement in the span - at mid-span for increased resistance to positive bending moments. In this case, reinforcement may also be required to meet the fire resistance limit state. If they exist, they should be placed centered on the respective ribs and raised 30 mm in relation to the profiled sheet (see Fig. 8), and may be interrupted in the area of the supports.

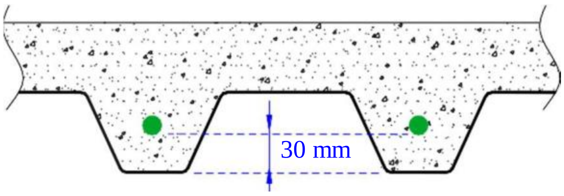


Fig. 8 – Layout of additional reinforcement in the span.

Fig. 9 shows a schematic representation of the three aforementioned reinforcements.

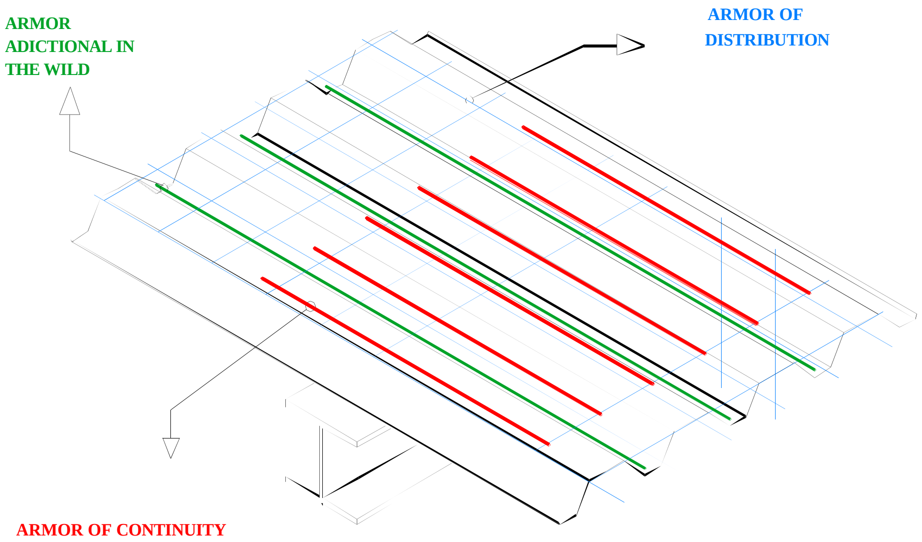


Fig. 9 – Schematic layout of reinforcement in composite slabs

Fixing the profiled sheets to the supports

The profiled sheeting must be fixed to all permanent supports. At the very least, there should be one fixing for every two profiled sheet ribs (see Fig. 10). However, it is up to the designer to define these fixings, taking into account the expected construction loads and essentially the action of the wind. When supporting metal beams, it is common to use connectors and self-tapping screws to make these fixings. If the beams and the composite slabs are concreted simultaneously, the profiled sheeting will have to be fixed to the beam formwork using removable elements after concreting, which should not damage the composite slab.

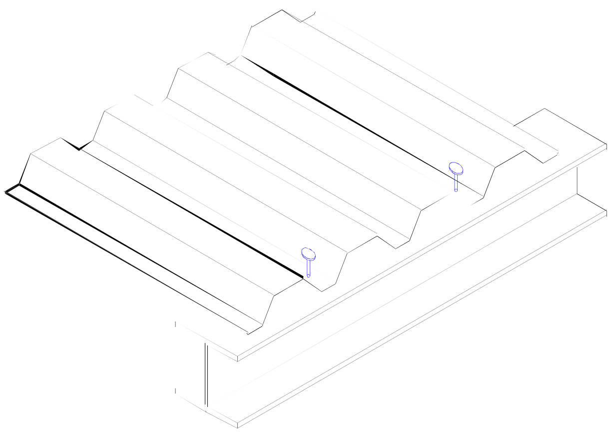


Fig. 10 – Fixing the profiled sheets to the supports (using welded connectors)

Bracing of profiled sheets

Fig. 11 illustrates the minimum support width for profiled sheeting in temporary shoring (80 mm).

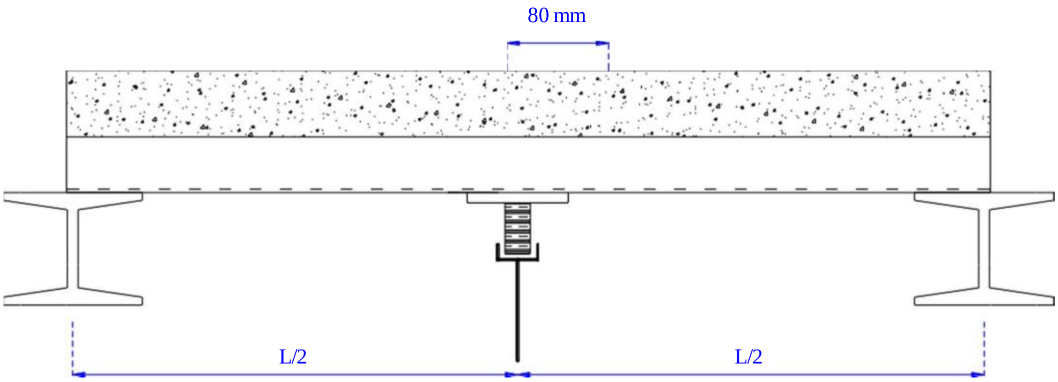


Fig. 11 – Support of profiled sheets on temporary shoring (one line of shoring shown).

During the concreting phase, it is necessary to ensure that the ends of the composite slab are prepared to prevent the concrete from escaping and to ensure that it vibrates correctly. It is common to use sheet metal ends that are suited to the specific geometry of the ribs of the composite slab.